DOCUMENT RESUME

ED 159 790 EA 010 899

AUTHOR Willett, Edward J.
TITLE "R & D"--and the "Three R's": Incentives for School Districts' Research and Development Expenditures to Promote Increased Productivity. Occasional Paper #11.
PUB DATE Apr 78
NOTE 34p.

EDRS PRICE MF-$0.83 HC-$2.06 Plus Postage.
DESCRIPTORS Cost Effectiveness; Educational Technology; Elementary Secondary Education; Individualized Instruction; Man Machine Systems; Productivity; *Research and Development Centers

ABSTRACT

Reduced or stabilized costs of education can only be attained by positive changes in productivity as defined by the ratio of outputs to inputs. Educational units or districts could do research on productivity improvement at low costs if they combined for such research and development (R and D) activities. The area of productivity research that holds the greatest potential for cost improvement is in the labor component of local school budgets. In general, when inputs are transferred from labor-intensive to capital-intensive, productivity increases. Large productivity gains and improved costs are offered by capital-intensive learning arrangements that emphasize (1) instructional differentiation, (2) complete integration of educational technology in a systems approach, (3) individualization of student learning (to harness student time and energy more fully), and (4) specialization of labor functions into professional, paraprofessional, and student assistant functions. The area where the greatest productivity gains in real resources (and in educational costs) can occur is in the development of pilot models of learning-theory-designed man-machine-systems of individualized instruction that integrate human and nonhuman media. In addition to monetary gains, R and D on productivity improvement can also lead to nonmonetary payoffs such as improved community relations, professionalization of educators, and student involvement.
(Author/JM)

**********
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
**********

ED159790

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

NY State Educ. Dept.

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

OCCASIONAL PAPER # 11

# "R & D" -- AND THE "THREE R'S":

## Incentives for School Districts' Research and Development Expenditures to Promote Increased Productivity

EDWARD J. WILLETT

Public Law 93-380,
Section 842 Staff:

Orlando F. Furno
Charles T. Nephew
William J. Fowler, Jr.
James M. Gaughan

April, 1978

EA 010 899

OCCASIONAL PAPER #11

"R & D" -- AND THE "THREE R'S":

INCENTIVES FOR SCHOOL DISTRICTS' RESEARCH AND DEVELOPMENT EXPENDITURES TO PROMOTE INCREASED PRODUCTIVITY

"...in the sciences, and in true scholarship, the great advances are made by a patient willingness to reexamine what other people regard as obvious." (Stone, 1977:10)

Whether measured in absolute terms, or as a percent of the capacity of the economy to produce, American societal resources committed to education have reached an all time high. This might still be defensible as public policy if projections of future school age population pointed upward, or improvements of quality in education output could be readily quantified. Neither of these justifications for the increasing cost of education is valid. Instead, with the exception of two insignificant bulges in the 1980's and 1990's, enrollments are expected to decline, while the cognitive quality of elementary and secondary education is under serious attack by both educators and the public. To further compound the problem, schools of education continue to do business almost as usual, providing a teacher surplus that has acted as a catalyst for the organizing of ad hoc, as well as officially sanctioned, bargaining units to improve job security.

And as if these converging forces were not enough to present legislators, school officials, and taxpayers with a major dilemma, there has been emerging for the past thirty years what is now recognized as a revolution in the processing and dissemination of information of all kinds for all purposes, including

education. This so-called "fourth revolution"[1] either precedes, follows, or is coincident with a fifth, often referred to as the "knowledge explosion." As Toffler puts it, we need "imagination to confront a revolution" (1971:186), because

> Johnny must learn to anticipate the direction and rate of change. He must, to put it technically, learn to make repeated, probabilistic, increasingly long-range assumptions about the future. And so must Johnny's teachers. (1971:403)

Toffler's prescription: "transform the organizational structure of our educational system . . . revolutionize its curriculum, and . . . encourage a more future-focused orientation." (1971: 405)

## New Challanges for "R & D" in Education

In the days of drawing water from a home well, less effort was often expended by "priming the pump." This principle has been adapted to modern political usage, and is re-phrased, "seed money." The idea is that some agency, or foundation, somewhere, has some unused income which can be invested in some new research which will result in some more efficient process that will eventually make national income larger and thus replace, indirectly, the initial injection. There is only one problem: less and less "seed money" seems available, at least in education, because the resources which might otherwise be released to provide such funds too often are committed to perpetuating the production of

---

[1] "The first occurred when societies began to differentiate adult roles . . . and the task of educating the young was shifted, in part, from the home to the school. The second, which in some places antedated the first, was the adoption of the written word . . . The third revolution came with the invention of printing . . . " (Carnegie Commission, 1972:9)

education by processes that are no longer intellectually adequate nor technologically efficient.

The initial goals of improvement of American education (which have become formalized in the specific account numbers of school budgets) are still laudable: (1) academic freedom in the classroom, for which tenure was at least a partial protection; (2) the minimization of health and job-security risks (because of relatively low-paying teacher salary scales) through fringe benefits; (3) improved administration in all areas of instruction and support services (by the hiring of administrative specialists); (4) centralization and/or consolidation of school districts (whereby economies of scale tended to more than offset increased maintenance and transportation costs -- at least for a time); and (5) the upgrading of (a) instructional staff (through higher certification requirements) and (b) of instructional services (with the "add-ons" of audio-visual devices).

Yet, the "price" of elementary and secondary education has continued to rise, as expressed in tax dollars; the primary consumers of education -- students -- have become more and more restless concerning "time in school;" and the secondary consumers -- taxpayers -- have frequently claimed they are obtaining less and less for the "price."

Any careful review of the voluminous literature of the past fifteen years on the general question of "what is wrong with American education" will reveal (1) an almost pathological preoccupation with trying to define "educational output," and (2) an almost complete lack of any rigorous research and pilot-

model demonstrations of a rearrangement of the inputs of education into less labor-intensive and more capital-intensive models.

With reference to education as output, it has been an economic axiom for over one hundred years that the consumption of a good or service (and therefore the demand for same) is not a function of its quantitative (therefore objective) measurement but of its "utility," i.e. the satisfaction received by the consumer (obviously subjective). It seems almost ironic that this myopic focus on so-called "cognitive" achievement as the output of education should be such a public issue when not only economic theory, but even the motto for the State University of New York suggests that the real output of all education is the opportunity for each to become what that person is capable of being, which is the true utility of education.

Once output is thus re-defined, attention immediately shifts to the input, or cost, side of the equation:

Price (of Output) = Cost (of Inputs)

This first permits examination of the real resources (or non-monetary inputs) involved in the creation of a learning environment, and only, second, translates this into nominal (or monetary) units. If these real inputs can be properly rearranged to produce the real output as defined above, then the monetary statistic, or cost, is at least defensible. Paradoxically, because of the revolutionary changes in the acquisition of new knowledge, and the ability to process and disseminate same, proper re-arrangement of these real inputs can also result in lower monetary costs. It is the dearth of research and development in this

area of cost improvement which is such a glaring omission in modern educational literature.

## The Concept - and Reality - of Productivity

Productivity is defined in economic theory as a simple ratio -- output divided by the input(s). It has been traditional to measure changes in productivity in terms of man-hours. This is admittedly simplistic at the micro level although occasionally useful in macro comparisons.[1] When examining any specific unit of education production -- a school district -- productivity changes can only be a function of all of the inputs working together. Economists term this: "total factor" productivity. In all education production functions, the "factors," or inputs, as stated in real terms, follow.

1. The "labor" component includes all educational personnel: administrative, instructional, maintenance, and support.

2. The "material" component consists of those to be educated -- students. It is a gross error to view this input as anything but "semi-finished," since by school age, and at any subsequent educational level, children and older students have already received varying degrees of "finishing," or conditioning. This is currently labeled "cultural (or socioeconomic) background," and as Coleman et al (1966) and numerous other studies have shown, is the most important identifiable variable in student achievement.

3. The "capital" component includes: school fixed assets

---

[1] For example, the number of man-hours to produce a pair of shoes in Country A, versus ditto in Country B.

(buildings, busses, etc.): all nonhuman media (books, electronic technology, etc.): and all community resources which are external to, but available for, attaining the goals of education. Only certain items have been conventionally selected from this assortment to become the capital input in education. These are: books, busses, buildings, sporadic injections of electronic media, and occasional, selected community resources. It is not any single input, but the mix of these three components, which determines the productivity of any education production function, and therefore determines the cost of education. The reason for this axiom is the following relationship:

> When the change in productivity is positive, unit cost falls:
> When the change in productivity is negative, unit cost rises.

Positive changes in productivity have both immediate, and long range effects. In the short run, they will result in (1) a reduction of, and/or stabilization of, present educational costs, and (2) the adequate provision for future costs (which is the proper definition for what society calls "profits"). In the long run, such positive changes in productivity generally result in more, not less, employment of people, though not necessarily in the same sector.[1]

All sectors of society benefit at various times and in various ways from increases in productivity. Education itself, beginning one hundred years ago, began to experience such positive benefits by moving into a period of "mass education" which, given

---

[1] This assumes national policies which assure attention to balanced growth in aggregate demand. Bi-partisan agreement on such policies is found in the Employment Act of 1946.

the then existing technology, and the societal goal of raising the literacy level, kept educational costs from rising as rapidly as they could have done had the society attempted to extend the concept of individualized learning then present in the American Common School to the rapidly expanding population.

In a near-21st century world, sometimes called post-industrial, both the technology of, and the societal goal for, education have changed. The change in technology is not only well-documented, but ubiquitous. It is the change in the goal of education which people conditioned to the 20th century have difficulty in recognizing. As the average level of literacy rises above the present secondary level of education, people tend to become both more analytical and more critical. While a competency level of literacy is still a necessary ingredient of the output demanded of education, an increasing percent of the human expectations relating to education is in the intelligent and literate application of knowledge to human problems. There seems to be ample evidence that this dimension of what is expected of education today even affects the behavior of students, most of whom are sufficiently perceptive at relatively early ages to sense that there must be a "better way" to educate.[1] Many students, as well as parents, have become aware that the supposed correlation (on the average) between greater amounts of education and higher levels of lifetime income may be far less a function of schooling and far more a function of socioeconomic background than previously thought, a point made by Atkinson (1975).

---

[1] As samples of this literature, see Kozol (1967) and Silberman (1970).

Thus, the primary and secondary consumers of education -- students and parents, respectively -- want more than attempts (however sincere) to deal with productivity in education (as the inputs are presently arranged) through techniques of "cost-effectiveness." They want what this paper contends they are at present unable to verbalize: research into, and demonstration of, rearrangement of the inputs of the education process to take full advantage of the known developments of educational technology. Burkhead et al (1967) and Baumol (1967), among others, have already established that we have reached the limit of increases in productivity in education, using traditional input mixes. In the words of Burkhead:

> we will not be able to assess the outcomes of ....innovations unless systematic attention is directed to resource costs, to resource combinations, and to educational outputs. (1967:94)

Baumol adds that education today has only "sporadic increases in productivity" because

> .....despite the invention of teaching machines and the use of closed circuit television and a variety of other innovations, there still seem to be fairly firm limits to class size.....Without a complete revolution in our approach to teaching there is no prospect that we can ever go beyond these levels (or even up to them). (1967:416)

The key to movement in new directions for the production of education is suggested by Katzman when he points out that we have little understanding of "social technology" which he defines as "the controllable factors that contribute to the existence of a social problem, and thereby to its potential solution."

In recent study on state aid to education, Cohn and Millman (1974:93) state:

> .....most schools are either too large or too small, resulting in considerable waste of resources to society. Yet the state aid formulas provide virtually no incentive to schools to reorganize along lines that will increase efficiency.

New York State may have been one small exception to this criticism with its policy, now rescinded, of offering a strong monetary incentive for too-small central school districts to consolidate. In retrospect, the basic weakness of the policy appeared to be the lack of mechanisms that could authoritatively demonstrate to local citizens the long run reductions in cost which would accrue. Cohn and Millman, however, (1974:103) offer as "incentive features.....to encourage schools to organize along lines that would minimize adjusted unit costs" some very traditional approaches:

> .....a penalty factor for excessively high adjusted unit costs in a given period; incentive payment for cost savings between the preceding and current time periods; and a combination of the two plans.

## Is There a Better Way?

Any experimentation or research into ways to improve productivity in education is doomed to failure unless it is first ascertained what areas are least apt to develop payoffs. An effective way to isolate such unlikely areas is to list the items of a typical school budget which individually, and in toto, make up relatively small percentages of the final budget sum. In general, this will comprise: debt service; consumable materials and supplies; general office expenses; and transportation. The remaining budget items turn out to be almost exclusively those which have a very high relationship to human effort -- i.e. labor.

These budget items are: instructional salaries; support salaries; and employee benefits.

Again, using elimination, the support salaries for custodial, health, and secretarial assistance are relatively small. The largest single item in any school budget is for instructional salaries. Similarly, the amount of employee benefits which are related to support salaries is also small, while that related to instructional salaries is large, since benefits are a function of the -ase salary structure in each category.

Thus, because of considerable rhetoric concerning student-teacher ratios, we come to a most difficult question to ask -- but the mandate of this paper is to ask hard questions. Are there too many people in face-to-face, or group, instruction in American schools? The answer is: not necessarily. Next question: are there too many highly specialized and highly trained people in pure information transmission? Answer: a qualified yes. Why the qualification? Because it is necessary to have a limited number of highly specialized and highly trained individuals for information transmission. Some must have exceptional verbal ability, and some must be exceptional in technical expertise; however, those who are highly trained in information transmission, per se, are only needed where the learning "mix", as determined by learning theory, indicates that the most learning will be accomplished using their abilities. Otherwise, less highly trained -- and paid -- paraprofessionals, plus numerous student assistants at minimum wage levels, plus a whole range of non-human media (which can perform at much lower per hour cost

because the human time element is largely that of the learner) will accomplish the same tasks of information transmission at the same, or better, levels of achievement plus the added benefit -- difficult to quantify but extremely important -- of real student interest and involvement in the learning process. The inescapable conclusion of this assessment is:

The area where the greatest productivity gains in real resources (and in quantifiable monetary units of educational costs) can occur is in the development of pilot models of learning-theory-designed, man-machine-systems[1] of individualized instruction which integrate, by function, human and nonhuman media.

The basic research for the construction of such systems has been completed. A few experimental partial models are in operation: Glaser in Pittsburgh, Bitzer at University of Illinois, and others. Some beginnings in estimating the cost implications of the productivity gains of fully developed and operational models have been made by Willett (1973) and Swanson and Willett (1977). A compendium of the range of research to 1970 can be found in Tickton (1970).

In essence, a man-machine learning system is an updating of the managed-learning concept of the American Common School, which Morrison (1940) described as continuous (rather than discontinuous) learning. The sizeable productivity gains, which Willett

---

[1] Loughary, et al (1966:5) has defined a man-machine-system as "a set of planned procedures in which man and machine capabilities are used in an integrated manner to achieve results man could not achieve without the machine."

estimated can average 30 percent or more of per student per year instructional costs, are obtained from three areas: (1) greater specialization and division of labor in diagnosis, prescription, instruction, and evaluation; (2) harnessing the energy-and-time of the learner in self-education, which is the only "in-school variable" documented as being highly related to student achievement; and (3) using nonhuman media in an integrated (often individualized) manner for major portions of the necessary transmission of information to the learner.

Given what present research shows, there appears to be no reason why combinations, or groups, of school districts cannot pool resources to plan, develop, and operate pilot models of such man-machine systems within the next five years in New York State. A framework for such cooperation already exists through the Boards of Cooperative Educational Services. Swanson and Willett (1975) estimated that such a model could be developed over a period of five years (or less) at a total cost of $1.64 million, of which $0.6 million was for "hardware," large amounts of which are presently gathering dust in every school district in the State. The contribution of this hardware on either an "in kind" or loan basis by a group of school districts would reduce the estimated developmental cost to approximately $1.0 million. If this amount were shared by any combination of districts with a total student population of 40,000, the cost per student per year would be $5 over a period of five years; for 20,000 students, $10, and so on. When compared with the potential per student per year saving of a man-machine system,

these developmental costs are extremely small. At the median level in Western New York State in 1974-75, the per student per year cost for "Instruction Services/WADA" was $932. If even ten percent of this were saved, development of an alternative pilot model of a man-machine system would be amortized[1] in the first six and one-half months of the new man-machine system for a combination of 20,000 students, and in the first three and two-tenths months for a combination of 40,000 students.

The obstacle to obtaining such gains in productivity in education is not the monetary cost, but the social trauma which the fear of social change creates. This would be greatly minimized if any research and development efforts by school district combinations could incorporate substantial community personnel and resources at the outset. Even at another $1 or $2 per year per student, the cost would be minimal, while the education of the community to the long-run potential would be maximum.

## Jobs, Security, and Tax Dollars

Before any major shift from labor-intensive to capital intensive education can occur, there must be a carefully coordinated

---

[1] In a combination of 40,000 students, the developmental cost, using contributed or loaned equipment, would be $25 per student for five years (at $5 per student per year). This is .268 percent of the $93. per student per year saving when the model is operational. It would thus take 3.2 months (.268 x 12) of the first operational year of a man-machine system, at $93 saving per student per year, to amortize the $25. of developmental expense. For a combination of 20,000 students, the $50. of developmental expense could be amortized in 6.5 months of the first year of a new system.

and implemented program to disseminate the knowledge already contained in existing research. This needs to be done indirectly, through all kinds of "media methods," and directly, through a few low-key demonstration projects. Prior to his 1967 input/output study of education, Burkhead (1964:359) pointed out that

> the task of those who wish to strengthen public education is very much the same: to change the preference patterns of citizens, to organize political leadership, and to encourage the kind of administrative and organizational changes within public education that can produce more effective results.

Usdan (1963:2), and many others, have argued that "public schools are a political enterprise because education must compete with other governmental functions for limited resources." Thus, in addition to dissemination of our present level of knowledge (on how to improve productivity in education) to the constituency of education -- parents, students, teachers, and taxpayers -- there must be a "political will" to accomplish this task by all leadership in all sectors related to education -- administration, labor relations, and legislation. In the words of Coombs (1967: 167-168):

> people most directly involved in education must be convinced that there is no other way out of the crisis...that educational systems must themselves become equipped with the means for innovation.... there must also be an order of priorities.

The "priorities" Coombs mentions are modernization of "educational management"... "teachers"... and "the learning process."

How can such "modernization" be brought about? Ziegler,[1] in CERI (1972:95), reminds us that it is necessary

---

[1] Warren Ziegler, "An Approach to the Futures-Perspective in American Education."

> for an understanding of change and reform in American education to realize how much occurs in response to crises, the dimensions of which are not earlier perceived by the officialdom of the system.

The "crises" of the present certainly include: (1) wide dissatisfaction with what education is "producing"; (2) dismay at the continually rising cost of education; and (3) little discernment of any solution(s). But these very crises can become the impetus for the creation of innovative action, and such action can literally be "financed" out of the potential monetary saving.

It is this monetary payoff which is the most obvious incentive for school district combinations to embark upon their own research and development programs. The research aspect should be composed of at least three sequential steps: (1) verification that the existing research concerning education already contains what is needed to accomplish solutions to the problem; (2) adaptation of the known research to a specific regional situation through concept papers and proposals;[1] and (3) determination of planned mechanisms and procedures leading to pilot projects. For the development portion of such programs there needs to be: (1) some initial "seed money"; (2) a financial commitment to ensure the continuation of any pilot project for sufficient time to adequately evaluate its potential; (3) a long-range plan for moving from the pilot stage to a capital-intensive mode of education; and (4) contingency procedures to modify, or re-direct, the ongoing process of change as new events, or research, come

---

[1] The region might be a BOCES area, a County, an Urban combination, etc.

into focus.

Assuming administrative commitment at the top level of any combination of school districts seeking to embark on such a research and development program, the first crucial step will be the identification and selection of personnel within the cooperating districts who can become a cadre to "sell" the necessity of the R & D approach. The members of this cadre must command the respect and trust of all members of the constituency and for that reason must include representation from administrative circles, teacher organizations (whether union or non-union), parents, students, the business sector, and the general community (e.g. taxpayer organizations, senior citizen groups, etc.). The consistent message which this cadre must present is that the ultimate monetary payoff of the R & D approach will mean no economic loss to any group involved, since known research already indicates that the potential saving of societal resources is present.

Clearly, such a message will be more readily accepted and believed if there is a formal gurantee at the State level that the monetary saving which accrues as a result of R & D efforts by school district combinations will be reflected in lower local taxes. This could be accomplished by some formula which would allow the initial round(s) of saving to go to tax reduction at the local level without an offsetting reduction in state aid. Such a formula might have to be individually negotiated during some pre-determined time period to assure that both the State and the school district combinations were fairly treated.

The monetary payoff from R & D expenditures which move education production into less labor-intensive arrangements also must be shared with the teachers through their organizations if teacher support for change is to be obtained. The obvious monetary saving inherent in capital-intensive modes of education lies in (1) instructional differentiation,[1] and (2) the specialization of instructional labor functions which, with the exception of content areas, are today quite homogeneous. Any restructuring of the present system inevitably will have to deal with the "security blanket" of tenure. Here the monetary payoff will be most effective if, in addition to lowering taxes, it is used to offset any economic loss due to early retirement, or to cover any additional costs of re-training younger educational personnel. Computer simulations of both the short run and long run statistics involved in these transitions should be a part of the total research effort.

Movements of labor are essential if a society is to improve its productivity through technological change, but it does not follow that it need be financially embarrassing to those concerned.[2] Mansfield (1971:110-111) lists five union policies

---

1 The relationship between the proper "mix" of human/nonhuman media given the following variables: instructional content, cultural background of student, and, in certain situations, age and sex of the student.

2 The classic case in modern labor history is a unique pact (signed in 1961 between the Pacific Maritime Association and the International Longshoremen's and Warehousemen's Union) known as the Mechanization and Modernization Agreement, which allowed ship owners to automate as necessary, and over a 5½ year period give the union $29 million as its share of the savings. In addition, a new approach to job security was also developed. (Wall Street Journal, November 20, 1964, page 1).

which may be used with reference to new methods; (1) willing acceptance; (2) outright opposition; (3) competition with the new technique; (4) encouragement of change; and (5) adjustment to change. Careful research into the literature of labor relations will reveal how to emphasize policies (1), (4), and (5) while avoiding policies (2) and (3). To assure that teachers do share in the monetary benefits, there needs to be a firm policy established at the State level that collusion by school boards to exclude teachers from a fair share of the monetary saving will not be tolerated. This might be included as a penalty clause in any formula worked out to allow a portion of the saving to be used to reduce local school taxes.

Except for the fact that lower school taxes would give parents more disposable income which might indirectly benefit students, the probable monetary payoff for students will tend to be in the adolescent years. The reason will lie in the fact that if R & D approaches to improving productivity in education are made, the realization will occur that it is not "time in school" i.e. the length of the school day, or school year, but the "time in actual learning" which determines cognitive achievement. Since the time in actual learning in any school day probably averages no more than three hours per student, a capital-intensive rearrangement of the use of school resources (because it focuses on time in learning) will indicate that the same school resources could actually handle more, not less, learning time. The resulting "free time" bonus could be used by older students for income, either as paid student assistants, or as paid interns

or job apprentices in the community, all such activity being arranged as part of the total learning experience.[1]

Other than tax saving, parents of pre-adolescent children are the least likely to benefit monetarily from R & D approaches to new education production functions. Present schooling arrangements for younger children provide both education and child care. Both are intermingled during any given school day. For parents in this category, the use of a share of the monetary saving accrued in more productive education processes to provide child care for up to one-half day (opposite the half-day of instruction), would be an attractive encouragement to support new arrangements in education. Such child care could be accomplished either on school premises or in other community facilities, using trained, well-paid supervisors, plus older students as assistants who would be paid at the minimum wage base. Since such centers would be technically part of the schooling function, they would make ideal laboratories for researching the affective, and psychomotor parameters of learning. These areas receive little attention in conventional schools other than for the "exceptional" (usually translated "problem") child.

Finally, there are monetary gains for all sectors of the education constituency because capital-intensive learning achieves fully individualized instruction, and continuous learning. The harnessing of a major portion of now unused (often mis-used) student energy releases human resources from the primary func-

---

[1] Employers desire employees with "experience." Society as a whole benefits if the community and the school collaborate in providing such experience. Crime deterrence is also a likely spin-off.

tion of information transmission, and reallocates those resources to program each pupil's progress at the rate that that pupil can best accomplish pre-determined learning goals. As it turns out, this individualized, continuous learning also has a "non-monetary payoff" for adult educators.

## So-Called "Intangibles" Are Often Real

A friend, who was formerly a school principal, told me that frequently teachers in his school would complain: "We could get our work done if it weren't for these kids." To which he would reply: "The kids are why we are here." Such an interchange should not be considered as evidence that few adult educators like kids, although Silberman (1970) said he did find a large enough number who did not that he was astonished. A much more probable interpretation, given the varieties of human personalities and skills, is that most adult educators have a real concern for their work as administrators, teachers, etc., but resent the extremely limited opportunities afforded them to specialize creatively in the area of educational expertise where they feel the most comfortable. For some, this is the classroom; for many it is not. Pay scales, however, are structured to enter as a beginning teacher, then move to certification, next to tenure, and for a smaller number, to junior, or senior, administrator. Instead of being based on specialized competence, as in most areas of society, the pay of educators is largely determined by amount of schooling, and length of service.[1] True

---

[1] Neither of these is at all significantly correlated with student cognitive achievement.

professionalization occurs infrequently, if at all.

For educators, the most important non-monetary payoff of more productive, capital-intensive education would be the opportunity to exhibit what Vollmer and Mills (1966:43-44) designate as the "basic elements" of professionalism:

> ...(1) acquisition of a specified technique supported by a body of theory; (2) development of a career supported by an association of colleagues; and (3) establishment of community recognition of professional status.

A "new" (or true) professional as envisioned in capital-intensive education would be a specialist in one or more content areas, and/or a specialist in one or more procedural techniques (e.g. diagnosis of learning strengths and weaknesses, curriculum prescription, motivation and facilitation skills, curriculum programming, and achievement evaluation).

Much more esprit de corps would also attend the work of paraprofessionals. As described by Willett (1973):

> Paraprofessionals will also tend to specialize in both content and procedural techniques. In content this may involve subareas of knowledge (e.g. arithmetic competency). In procedural techniques, a range of skills is probable.....Paraprofessionals are also educable within their rank.....Some paraprofessionals will undoubtedly move on into the professional group as a result of both formal and on-the-job educational experience.

Legatt in Street (1969:182-183), discusses how the teacher's role is affected by paraprofessional provision of a "supplementary academic service for students," and is restructured as "a vertical rather than a horizontal...differentiation of work;" but Conant (1973:129) in a comparative study of professional/paraprofessional-teaming-productivity in education summarizes:

> The finding of this study that teachers produce so relatively little instruction, even when they are teamed with paraprofessionals, is a result that should prompt widespread experimentation with alternative staffing arrangements.

While Conant's "alternative staffing arrangements" is obviously related to conventional (rather than capital-intensive) education, he has confirmed an important point when he concludes:

> What we believe the study has established is that specialization of teacher work for more professional performance cannot proceed unless the traditional teacher work role is abolished and teachers are freed to instruct on a more full-time basis.

True professionalization of educators at various levels is not only an attainable goal, but is actually accentuated by movement to higher levels of technology in production. As Vollmer and Mills put it:

> ...one of the factors that promotes professionalization in modern society is technological change, especially the rapid and advanced technological change to which we are subject in this second half of the twentieth century. (1966:21)

In addition to meaningful professionalization on the part of those in education, a second non-monetary payoff of R & D programs for improved productivity in education is in the realm of community involvement and community relations. Unless perceived in advance and controlled for, much technological change can result in the depersonalization of society so that alienation from, rather than integration into, the community results. In the case of capital-intensive education, however, the opposite result is possible, since both student and teacher, through

---

[1] Timothy Legatt, "The Use of Nonprofessionals in Large-City Systems."

the individualization of learning, are freed to explore as a part of the total learning process the diversified resources afforded by most modern communities to their youth. It is here that continuous learning is at its best. Tyler, in Rubin (1975: 173), points out that occupational specialization and the increased length of formal education[1]

> ....are chiefly responsible for the high school and college becoming adolescent islands in which youth are isolated from the larger society. This creates conflict for youth....In the past, young people had many more opportunities to move gradually into adulthood....

In Tyler's view, high schools are "in a favorable position to arrange with other institutions for students to have experience in community service, in real jobs, and in other constructive activities in which they share responsibilities with adults." (1975:174). Such involvement between schools and their communities can have very positive benefits with respect to community relations.

A third non-monetary payoff from R & D aimed at increased productivity in education will be found in two aspects of the role of the student. I have labeled these the use of "student assistance," and the use of "student assistants." The first relates to plan; the second relates to process. Shane in Rubin (1975:112) cites what he calls "adult imperialism" in educational policy and practice. By this he means

> adult planning of education without sufficient heed for the ideas of learners of all ages... adults do not have the omniscience to make all

---

[1] Ralph W. Tyler, "The School of the Future: Needed Research and Development."

> the requisite educational plans. Rather, there should be more planning with the young.

Since the capital-intensive mode of education is essentially a system's approach, the design of any learning system is central to its success. A large body of research is now available to assist in developing such designs, the evaluation of which necessitates not only the consideration of cognitive achievement scores, but various other instruments, such as student questionnaires and informal discussions. These provide essential feedback for the improvement of the instructional design. Davis et al (1974:113) comment;

> All teachers are interested in knowing how they come across to the students. When preparing instruction, teachers have certain expectations about the results. . . .There is no better way of obtaining informa ion to evaluate these expectations than to ask the students themselves.

What is especially significant is that students observe the method of instruction as well as the content, and as Davis points out, they "often suggest alternative approaches which result in improved instruction." (1974:104)

In the American Common School of the 19th century, the use of students as assistants in the process of learning was a frequent practice. The teacher had usually completed the equivalent of a secondary education -- and perhaps some Normal School training -- but must deal with learning levels from Beginning at least through the equivalent of 8th grade. To accomplish this involved "management" of each learner's program, and the delegating of drill and practice, some specific content tutoring, and other minor instructional chores, to older students, or to

those "more advanced" in some content area. The only monetary payment was to the teacher; but the students who assisted in the learning programs of other students gained the invaluable insight that there is no better way to learn, and expand your learning, than to attempt to communicate the concepts to be mastered to others. This benefit of "learning by doing" was to a large extent lost to American education as the Common School gave way to programs of mass education. Today, the use of capital-intensive, individualized systems permits the re-introduction of this valuable adjunct to learning, whereby student assistants not only extend the differentiation of staffing for the accomplishment of lower-order educational tasks with minimum financial outlay, but, what is even more important, acquire specific non-monetary benefits for themselves, and in turn for their society. A most useful survey of the literature on peer teaching by children and youth is found in Gartner et al (1971).

Finally, there is probably no payoff, of a non-monetary nature resulting from R & D into improved productivity in education, that could have greater societal benefit than the potential reduction in the number of confrontations between school boards, teacher unions, citizens' groups, municipal governments, the courts, and even State government itself. The key to such reduction in adversary relationships is a concept which is now beginning to make its appearance in the private sector, and which holds great promise for the public sector as well. I refer to "productivity bargaining."

Productivity bargaining is derived from a very basic and

familiar economic truth: nothing is produced in today's world which does not involve all the components of production -- capital, labor, and materials. No one component alone, can accomplish the task. Each input is interdependent with the other inputs. Together they produce the output. Thus, low productivity, which is the inverse of high unit costs, is the responsibility of all the components in education, respectively, and jointly; while high productivity, resulting in lower unit costs, is also the joint responsibility of the inputs.

The only possible way in which the costs of modern education can be stabilized, or reduced, is by research into, and development of alternative arrangements of these inputs. In a study submitted to the President's Commission on School Finance (Averch, et al, 1971:156), the Rand Corporation stated:

> Researchers have examined many variants of the existing educational system...none of these variants has been shown to improve educational outcomes consistently. A fact often overlooked is that few have been shown to lead to significantly worse outcomes either...if these variants are not all equally expensive, then choosing the least expensive provides opportunities to redirect (or even reduce) costs without also reducing effectiveness (i.e., effectiveness as now measured).

Capital-intensive education production provides a range of alternative variants of the inputs of education. Willett (1973) has illustrated, and estimated costs for, two sample designs which indicate from existing research that large increases in productivity are possible. Research into other designs, and pilot-modeling, are essential to a determination of the most productive combinations.

The outcome of higher productivity and lower relative costs

has much more than a monetary effect. It relates to jobs, to job security, and to the relaxing of tensions, which the present competition for the scarce resources of society by the educational sector has raised to an all-time high. If, through the research and development of new education production functions, the components of education output can be united in the common goal of increasing productivity, the secondary consumers of education -- parents and taxpayers -- will have little cause for confrontation with the producers of education. Instead, I would expect cooperation in the enterprise of education to become the norm. This is the non-idealistic, pragmatic potential toward which existing research in education is now pointing. The only tragedy could be: failure to do what we know. May I suggest as a slogan: what should be done, can be done.

## In Summary

Because it has been necessary in this paper to range widely (though minimally) into both economic theory and learning theory, a brief review of the essential points is now in order.

1. Rising costs, declining enrollments, surplus teachers, and consumer dissatisfaction with the output of education, have created a dilemma for American schools as presently structured.

2. A revolution in the processing of information by electronic means makes human information transmission less necessary, except for certain special situations, and in turn, this information processing revolution is generating another revolution in the proliferation of published materials to be processed.

3. The status quo in education is concerned with education

output (which no longer has a definitional consensus).

4. Preoccupation with the output of education, however defined, distracts proper attention from the cost of education, which is determined by the inputs.

5. Reduced or stabilized costs of education can only be attained by positive changes in productivity, i.e. the ratio of the output to the inputs.

6. Inputs are total, and interdependent, but can be rearranged in various ways for the improvement of productivity.

7. In general, when the inputs are rearranged from labor-intensive to capital-intensive, productivity increases. These gains are real to society in the release of scarce economic resources for other productive use, bringing increased employment, and increased income, ceteris paribus.

8. Positive productivity increases in education can best be accomplished at the local level, but the research for increased productivity, and the development of more capital-intensive education production, cannot be financed by any single educational unit.

9. If educational units (or districts) were to combine for such R & D in productivity improvement, the cost would be minimal (stated in terms of per student per year), and would be returned (or amortized) very quickly by the resulting saving from the productivity gains which would accrue.

10. The area of productivity research which holds the greatest potential for such cost improvement is in the labor component of local school budgets.

11. Alternative, capital-intensive learning arrangements which emphasize (a) instructional differentiation, (b) complete integration of educational technology in a systems approach, (c) individualization of student learning (to harness student time and energy more fully), and (d) specialization of labor functions into professional, para-professional, and student assistant, promise large productivity gains and improved costs.

12. Equally important are the non-monetary payoffs which R & D into productivity improvement in education can provide. These are:

a. greater community involvement, and improved community relations, with a resulting relaxation in tensions;

b. meaningful professionalization of educators in all educational functions due to true specialization;

c. more effective student involvement in learning through listening to student ideas concerning instruction, and through the use of student assistants to help other students;

d. the reduction of confrontation crises between parents, students, teachers, and taxpayers, because of the new focus on cooperation to improve the productivity of the learning process.

* * *

There are always the cynics who say, "It is too good to be true." More often in history than we realize, the cynics have been wrong. As a recent commentator put it: in a free society the news always concerns problems; in a closed society, the problems exist but cannot be discussed. To put all of the preceding in perspective, please note Mansfield (1971:153-154):

> Modern technology is a tremendously powerful force that can allow man to live a fuller, longer, happier life. If we use this force with care, we can better our own lot as well as that of our less fortunate neighbors. Modern technology is no panacea, but used with wisdom it can accomplish a great deal.

Would the cynic rather say with Thomas Hobbes (1588-1679):

"Life is nasty, brutish, and short?"

## REFERENCES


Atkinson, A.B. The Economics of Inequality. London: Oxford University Press, 1975.

Averch, Harvey, Stephen J. Carroll, Theodore S. Donaldson, Herbert J. Kiesling, and John Pincus. How Effective is Schooling: A Critical Review and Synthesis of Research Findings. Santa Monica, CA: The Rand Corporation, December 1971.

Baumol, William J. "Macroeconomics of Unbalanced Growth: The Anatomy of Urban Crisis." American Economic Review, June 1967, 57(3).

Burkhead, Jesse. Public School Finance: Economics and Politics. Syracuse: Syracuse University Press, 1964.

-------- et al. Input and Output in Large-City High Schools. Syracuse: Syracuse University Press, 1967.

The Carnegie Commission on Higher Education. The Fourth Revolution: Instructional Technology in Higher Education. New York: McGraw-Hill, 1972.

Centre for Educational Research and Innovation. Alternative Educational Futures in the United States and in Europe. Paris: Organization for Economic Cooperation and Development, 1972.

Cohn, Elchanan, assisted by Stephen D. Millman. Economics of State Aid to Education. Lexington, MA: Lexington Books (D.C. Heath and Company), 1974.

Coleman, James S. et al. Equality of Educational Opportunity. U. S. Department of Health, Education and Welfare, Office of Education. Washington: Government Printing Office, 1966.

Conant, Eaton H. Teacher and Paraprofessional Work Productivity. Lexington, MA: D.C. Heath and Company, 1973.

Coombs, Philip H. The World Educational Crisis: A Systems Analysis. New York: Oxford University Press, 1968.

Davis, Robert H., Lawrence T. Alexander, and Stephen L. Yelon. Learning System Design: An Approach to the Improvement of Instruction. New York: McGraw-Hill, 1974.

Katzman, Martin T. The Political Economy of the Urban Schools. Cambridge, MA: Harvard University Press, 1971.

Kozol, Jonathan. Death at an Early Age. Boston: Houghton-Mifflin, 1967.

Loughary, John W. et al. Man-Machine Systems in Education. New York: Harper and Row, 1966.

Mansfield, Edwin. Technological Change. Second edition. New York: W. W. Norton and Company, Inc., 1971.

Morrison, Henry C. The Curriculum of the Common School. Chicago: University of Chicago Press, 1940.

Rubin, Louis. The Future of Education: Perspectives on Tomorrow's Schooling. Copyright, Research for Better Schools, Inc. Boston: Allyn and Bacon Inc., 1975.

Silberman, Charles. Crisis in the Classroom. New York: Random House, 1970.

Stone, I. F. Former editor and publisher of I. F. Stone's Weekly, as quoted in The Wall Street Journal, March 4, 1977, p. 10.

Street, David, ed. Innovation in Mass Education. New York: John Wiley and Sons, 1969.

Swanson, Austin D. and Edward J. Willett. "A Pilot Model of Capital-Intensive Education to Promote Individualized Instruction and the Stabilization of Educational Costs." Proposal Submitted to the National Science Foundation. Buffalo: The Research Foundation of State University of New York in behalf of State University of New York at Buffalo, 1975.

Swanson, Austin D. and Edward J. Willett. "Updating the Little Red Schoolhouse: Toward Developing a Pilot Model of Capital-Intensive Education to Promote Individualized Instruction and Stabilize Educational Costs." Educational Technology, January 1977, 17 (1), pp. 27-33.

Tickton, Sidney G., ed. To Improve Learning: An Evaluation of Educational Technology. Volumes I and II. New York: R.R. Bowker Company, 1970.

Toffler, Alvin. Future Shock. Bantam edition. New York: Bantam Books, Inc., 1971.

Vollmer, Howard M. and Donald L. Mills, eds. Professionalization. Englew-od Cliffs, NJ: Prentice-Hall, 1966.

Willett, Edward J. Designs for Structuring Capital-Intensive (Rather Than Labor-Intensive) Education Production Functions for the Promotion of Individualized Learning Below College Level. Unpublished Doctor of Education Dissertation, State University of New York at Buffalo, 1973.